4 Silviculture[1]

Introduction

By 1951 it had already been realised that the rapidly growing population of Uganda, with rising living standards, were going to need supplies of saw-timber much greater than those available from the natural forests. This had led to a three-pronged attack: the improvement of regeneration in the natural forests after harvesting; the planting of indigenous hardwoods; and the planting of exotic softwoods.

For two decades there had been attempts to increase the stocking of high quality hardwoods in harvested forests by various types of line-planting and underplanting, but these all required labour-intensive and expensive maintenance and met with limited success, largely because of failure to open the tree canopy adequately. Over the period of this history, the policy moved towards securing natural regeneration, aided by two major developments: first the decision to adopt a monocyclic harvesting system which would both avoid damage to a young crop by the frequent fellings of a polycyclic system and admit more light to the young crop; and second the use of arboricide to remove 'weed' trees of species valueless as timber. Although biodiversity and biological conservation were seen to be important, it was thought that this could be achieved by setting aside one or more compartments in each forest as nature reserves, and these figured in most working plans for major forests. The economic imperatives of timber supply were the primary consideration, as modern international aid for conservation was not available to offset these.

Plantations of indigenous hardwoods for saw-timber also had a long history of limited success or failure. This was partly due to attempts to plant on unsuitable sites and partly to the depredations of various pests, large and small, which enjoyed the facilities offered by closely spaced plantation crops. The sad history of a scheme, which at first offered great hope, is recounted in Appendix E.

In the Kenya highlands, and further away in South Africa, plantations of exotic softwoods, mainly cypress and pines, had shown phenomenal adaptability and growth, and early trials in Uganda had reproduced this. It was felt that cheaper exports from Kenya might undercut Uganda supplies in the east and centre of Uganda, so four major sites in the west,

1 See 'Statistical Tables', Tables 6A, 6B and ALG 3B.

then remote from rail access though this has since been extended, were selected for a large plantation programme. These mainly comprised existing grassy hill protection reserves at 5,000–7,000 ft (1,500–2,000m) altitude, but there were some important differences between these sites. In the extreme northwest was Lendu CFR (and Use and Awung LFRs) in West Nile District with an annual rainfall of 55–60 inches (1,400–1,500 mm); in the mid-west were some hills in Toro District with a slightly lower rainfall and Rwoho in South Ankole, a large hilly area which was significantly drier (35 inches, 900 mm); and in the extreme south-west Mafuga in Kigezi District, which was both rather higher and wetter than the others and partly covered with bush rather than grass.

Large and successful plantations of Eucalyptus had already been established in CFRs to supply poles and fuel to the main centres of population amounting to 11,000 acres (4,000 ha), besides 1,500 acres (600 ha) with the main function of draining malarial swamps. Some additions to these were still required, particularly as LFRs in rural areas to supplement the 7,000 acres (2,800 ha) already existing there, but their silviculture was well established and a matter of routine. Moreover they were increasingly being supplemented by large and small scale private planting.

Plantation Statement

At 31st December 1951, the areas of plantations were:

	Fuel and Pole Plantations	Softwood Timber Plantations	Hardwood Timber Plantations	Anti-Malarial Plantations	Total
State Plantations	10,190 acres (4,120 ha)	1,390 acres (560 ha)	2,350 acres (950 ha)	1,460 acres (590 ha)	15,390 acres (6,230 ha)
Local Government Plantations	7,000 acres (2,830 ha)	130 acres (50 ha)	—	270 acres (110 ha)	7,400 acres (2,990 ha)
	17,190 acres (6,950 ha)	**1,520 acres (610 ha)**	**2,350 acres (950 ha)**	**1,730 acres (700 ha)**	**22,790 acres (9,220 ha)**

At 30th June 1965, the areas were (the changes in column 1 are just legalistic):

	Fuel and Pole Plantations	Softwood Timber Plantations	Hardwood Timber Plantation	Productive Planted Firebreaks*	Total
CFRs	10,960 acres (4,440 ha)	9,790 acres (3,960 ha)	3,190 acres (1,290 ha)	1,030 acres (420 ha)	24,970 acres (10,110 ha)
LFRs	12,830 acres (5,200 ha)	1,530 acres (620 ha)	—	80 acres (30 ha)	14,440 acres (5,840 ha)
	23,790 acres (9,630 ha)	**11,320 acres (4,580 ha)**	**3,190 acres (1,290 ha)**	**1,110 acres (450 ha)**	**39,410 acres (15,950 ha)**

*Mostly Eucalyptus in softwood timber plantations

PLATE 1

PLATE 2

PLATE 1. Plantation of mvule, *Milicia* (= *Chlorophora*) *excelsa*, at Aboke, Lango, aged 16 years. In excellent condition, with current annual girth increment about 1.5 inches (4 cm). This was one of the plantations in Lango and Acholi intended to replace the scattered mvule being felled in Busoga. (*H. C. Dawkins, 1958 Annual Report*)

PLATE 2. Photo from the same position as Plate 1 at 25 years of age (1956). Nearly all the mvule are dead, with the underplanted *Phyllanthus* and some *Maesopsis* (musizi) forming a thin canopy. The major causes of this failure appear to have been the drier climate, the lateritic soil and attacks of mvule leaf gall. Although some *Maesopsis* persisted, their growth did not match that of plantations on better sites. (*D. Leuchars, 1958 Annual Report*)

It is noteworthy that the Local Governments had overtaken the Central Government in establishment of fuel and pole plantations, a proper function for them.

State Timber Planting

During 1951, some modifications of regeneration techniques and programmes were introduced. These were due partly to the accumulated experience of past years, partly as a result of visits by EAAFRO (East African Agriculture and Forestry Research Organisation) specialists and partly to increasing labour shortages. The general tendency was for concentration rather than diffusion of effort.

PLATE 3

PLATE 4

PLATE 3. Mvule Leaf Gall (*Phytolyma lata*) showing the serious damage caused to young shoots, not only the leaves. This was one of the causes of the failure of many repeated attempts to establish plantations of mvule, *Milicia* (= *Chlorophora*) *excelsa*, particularly those in Lango and Acholi. This pest attacks mvule everywhere but seems less severe on scattered natural regeneration in banana gardens, the probable origin of much mvule in Busoga. (Uganda Forestry Department)

PLATE 4. A successful plantation of *Maesopsis eminii* (musizi) about 15 years old in Lwankima Forest, Buganda. This species has fast growth with tall clean stems, especially where there is an understorey, and provides a useful general purpose timber. On moist sites and good soils in, for example, Buganda and Bunyoro, it regenerates naturally in gaps and it is the most promising indigenous hardwood species for enrichment planting or plantations, as it is easy to raise in the nursery and unlike the mahoganies and mvule it is free from serious pests and diseases. It is an important source of food for hornbills, etc. which are also important in distribution of seed. (Uganda Forestry Department)

Lango and Acholi Hardwood Plantations

(See Plates 1,2,3, Appendix E and H.C.Dawkins 1949 Timber planting in the *Terminalia* woodlands of Northern Uganda. *Emp. For. Rev.* 28 (3), 226–247)

A further 210 acres (85 ha) were planted with mvule, mahogany and other species but the condition of these plantations (1,552 acres, 630 ha) gave rise to increasing concern during 1951. This area was chosen originally on the grounds of cheap and plentiful labour and absence of mvule gall; the former no longer existed while the latter had arrived. As a result of inspections by senior officers of the Department and measurements made in all the annual planting areas, the following conclusions were reached:

(a) establishment technique was so finely balanced in this area that any adverse factor such as failure to obtain labour at the right time would result in doubtfully successful establishment;

(b) if grass was not eliminated, a satisfactory crop would be unlikely;

(c) a 2–6% sampling of all areas indicated that while the survival rate of mvule averaged 88%, less than 50% of the trees showed promise of making reasonable trees in the final crop. Timber height seldom exceeded 20 ft (6m) in the oldest (10-year) crop, branching was low and a vigorous leading shoot was seldom seen;

(d) measurements in the younger age classes verified that planting shock virtually brings the large transplant striplings to a standstill for the first two years;

(e) it was believed that better results might be obtained under better climatic and soil conditions and that the increased vigour to be expected might render the young trees less susceptible to gall.

It was therefore decided to declare a moratorium on new planting, apart from beeting previously planted areas, and to concentrate on experimental work. This would involve:

(a) trials of different spacings of mvule in pure stands with a view to early elimination of grass; trials of stumps as against striplings to study the effect of transplant shock; these were to be established both under natural woodland shade and after clear felling. Electric fencing to be tried to exclude buck;

(b) experimental pure mvule plantings to be undertaken on optimum forest sites in Budongo and South Mengo.

Further extension of underplanting was suspended in 1952 and trials of closer spacing with a view to early grass elimination were begun. The normal maintenance of previously planted areas was continued in the face of grave labour shortages. Serious fires at Opit and Abera underlined the danger of failure to suppress grass. In 1954, the bulk of the work was experimental but very grassy areas in the 1950/51 areas at Opit and Kachung were weeded. This work was subsequently discontinued as results did not appear to justify the expenditure incurred. Moreover it was felt that intensive management of these older areas should await the outcome of research into methods of dealing with the overwood.

Experiments over the next four years showed that neither mvule nor any of the other timber species tried derived any benefit from being planted under a canopy, however incomplete, of indigenous woodland. Plots of mvule and mahogany established by the new techniques of so-called vigorous stump planting in clear-felled plots behind protection of electric fencing against browsing were no better in height or girth at six years of age than the same species planted as tall striplings in unfelled woodland in the period 1939 to 1943. Similarly, the formerly praised and latterly deprecated early plantings at Kachung, Opit and Abera contained many stems well up to the standard of the once spectacular plantations at Aboke and Jala (Lango District) which are now deemed to be failures. The disappointing conclusion was that mvule at least could not be raised to timber size in close plantation either in Lango, Acholi or Busoga but that it showed every sign of proving an ideal species for wide-spaced culture as might be achieved by a peasant planting scheme with fixed agriculture.

In spite of this disappointing conclusion, fire protection and boundary maintenance continued in the Lango/Acholi plantations for the next few years. In 1961/62, counts were made of mvule and mahogany which seemed to have a reasonable chance of growing to timber size. These showed that there were some good but scattered groups of mvule at Abera and, to a less extent, at Opit but very few at Kachung. In all cases, the survival of mvule was about double that of the mahogany. The figures indicated that there was some prospect of getting a crop off parts of these former planted areas. The next step was to consider a liberation treatment of those trees by poisoning their competitors, if the results of trials then in progress showed any response to liberation. Treatment continued in the plantations on an experimental basis in 1963/64 but results were still inconclusive.

At 30th June 1965, the area of the Acholi hardwood plantations was 850 acres (350 ha) and that of the Lango plantations was 560 acres (230 ha). It seemed a very disappointing and sad end to a scheme which had promised so much when begun.

Other Hardwood Plantations

(Plate 4)

In 1951, a further 233 acres (90 ha) of mixed mahoganies were underplanted in harvested forest in South Mengo at a spacing of 20 ft by 20 ft (6 m by 6 m). This work was continuing satisfactorily but it became apparent that the growth of munyama (*Khaya anthotheca*) could only be obtained on the best soils and that this species should not be planted on the poorer soils.

At Budongo, it was found necessary to stop any further diffuse planting at 75 ft by 25 ft (22 m by 7 m) as it had become impossible to obtain labour for the maintenance of these very extensive areas. Unless the young plants were freed from climbers and unless the necessary canopy manipulation was assured, survival and rate of growth were very poor. After consultation with the Silviculturist, EAAFRO, provisional conclusions reached were:

(a) compensatory plantations to be at 15 ft by 6 ft (5 m by 2 m) in pure plantations in heavily harvested forest;

PLATE 5

PLATE 6

PLATE 5. Trial plots of softwoods, North Rwenzori CFR. This is typical of many of the hills used for softwood planting – unforested, unsuitable for cultivation and with poor grazing.
(H.A.Osmaston, 1953 Annual Report)

PLATE 6. Recently pruned 5-year-old cypress (*C. lusitanica*) at Kyehara Plantation, Toro. This was previously similar to the landscape in Plate 1. At left, H.A. Osmaston, then DFO Toro.
(Public Relations Photographic Department, 1953 Annual Report)

PLATE 7

PLATE 8

PLATE 7. Softwood plantations of *Cupressus lusitanica* and *Pinus spp.* covering a valley at Mafuga Plantation, Kigezi. This is at a higher altitude (c. 7000 ft, 2000 m) than Plates 1 and 2, the original vegetation being lower montane bush and poor forest. Giant Lobelia are visible in the foreground. These and similar plantations currently (2001) supply the bulk of Uganda's sawn timber, but are not yet being replaced. (D. Leuchars 1956 Annual Report)

PLATE 8. A 30-foot span steel girder bridge in Use softwood plantation, West Nile, designed and constructed by district forest staff. This was in the most remote district in Uganda, and demonstrates how district staff had to turn their hands to many tasks besides growing trees.
(H.A.Osmaston, DFO, 1956 Annual Report)

(b) species to be mvule, munyama (*Khaya anthotheca*) and nkoba (*Lovoa*); later musizi (*Maesopsis*) was added;

(c) the first thinning to be mechanical to halve the crop when it was 35 ft (11 m) high but this to be reconsidered in four years' time;

(d) thinning or poisoning of the overwood to be completed before the first thinning and leading shoots to be kept free of interference during the intervening period.

In 1952, tending in Budongo was limited to opening up the 1946 and 1947 Khaya compensatory plots. A full programme for maintenance of the older plantations awaited the completion of sample enumerations in the 1,700 acres (690 ha) treated with climber cutting. The programme of line planting through harvested forest and reclaimed encroachments in Mengo was completed in 1954, as was canopy and line opening in the 1951 regeneration area of Zirimiti.

This type of work was replaced by natural regeneration treatments – one of the problems posed by the underplanting technique was always that of suppression. There was evidence that planted Khaya striplings, surviving but stagnant for six years, were capable of full recovery when the suppressive canopy was removed provided the whole forest area was given tree-weeding treatment. It was the linear silviculture which appeared to be unsound, not the diffuse planting.

Softwood Plantations

(plates 5–8)

From 1951 to 1964 the establishment of softwood plantations was pursued energetically chiefly in the Western Province and West Nile. The areas achieved ranged from 300 acres (120 ha) to over 900 acres (360 ha) per annum. The species composition was originally *Cupressus lusitanica* with lesser quantities of *C. benthami* and various species of pine but later the proportion of pine, especially *P. patula*, dominated the composition. Important factors influencing future work were recognised in 1951 after inspection and discussions with the Silviculturist, EAAFRO:

(a) the absence of the need for growing first quality knot-free timber for export;

(b) labour and staff shortages for pruning and thinning;

(c) disease incidence in relation to pruning;

(d) serious rat damage of cypress;

(e) ease of impregnation of pine timber as opposed to cypress;

(f) maintenance of herbaceous ground flora.

These factors led to the decisions:

(a) all species to be grown pure;

(b) C. *lusitanica* to be grown on class I sites – *P. patula*, *P. taeda*, *P. caribaea* and *P. radiata* on class II sites – *P. patula*, or failing that, *P. taeda*, on class III sites;

(c) spacing to be 6 ft by 6 ft (1.8m by 1.8m) – 7ft by 7ft (2.1m by 2.1m) on slopes over 20°;

(d) the first diagonal line thinning to be carried out when the crop is 25ft (7.6m) high – the second diagonal thinning when the trees are 35ft (10.6m) high.

In the following year, it was claimed that a better understanding of site classification was being achieved and that *Cupressus* must be confined to the more favourable sites with *Pinus* species taking over on the drier, rockier sites. The composition of planted firebreaks still gave concern and for the time being, close-planted *Eucalyptus saligna* and *E. citriodora* were being used.

In the Western Province plantations, there was a tendency to expand new planting with an inadequate labour force and this resulted in some of the younger crops stagnating under heavy grass cover while a considerable back-log of thinning and pruning accumulated. It was necessary, therefore, to reduce the area of new planting temporarily until larger labour forces had been built up and arrears of maintenance dealt with.

The Queensland Selection System was used in 1955 at Mafuga and West Nile for first thinning and pruning of young cypress crops with satisfactory results.

In 1958 the Working Plans Officer, H.A. Osmaston, returned from UK leave via South Africa and Swaziland, visiting many of the large softwood plantations there, the management and silviculture of which had already provided guidance for Uganda. Much useful, new and up-to-date information was gathered (Tech. Note 10/58).

The first thinning experiment was established at Lendu in 1958 in 5-year-old C. *lusitanica*. It embodied a revolutionary clinal design, the brain child of H.H.C. Pudden, Silviculturist, Kenya, whereby 16 thinning treatments were tested in a single rectangular plot of 4.8 acres (1.9 ha), the principle being that each treatment differed only fractionally from its neighbours. A second plot was laid out in 1959/60 at Mafuga. Both plots were assessed the following year and another pair were laid out in 3-year-old *P. patula* at Lendu. Modifications were introduced in 1961/62 due to objections on statistical grounds to the systematic order in which the treatments had been laid down. As a result, several replications had to be established at each site and orientated at random.

In 1963/64 two new plots were established in Mengo. J.N.R. Jeffers, Statistician with the UK Forestry Commission, recommended strongly that, wherever possible, pruning treatments should be imposed upon the existing thinning experiments and this was accepted by the Specialist Sub-Committee on Forest Research.

Although small compared with the other schemes, a new plantation at Kapkwata, in forest on the north slope of Mt Elgon, was interesting as being the only one in Uganda in which the *taungya* system was employed. Fifty acres (20 ha) were under licence.

A disturbing feature in 1958 was the high mortality of cypress at Awung in West Nile where C. *benthami* planted on a hill-side in 1951 died out in large numbers. At first it was

PLATE 9

PLATE 10

PLATE 11

PLATE 12

PLATE 13

PLATE 9. The Royal Mile, Budongo Forest. This is a publicly accessible example of natural moist semi-deciduous forest in Uganda, which has been carefully protected from harvesting. Numerous species are present in this mixed stand including mahoganies.
(*Khaya* and *Entandrophragma* spp.). (D. Kershawg, *The Forests and the Forest Administration of Uganda*, 1961)

PLATE 10. *Entandrophragma angolense* (Budongo Mahogany, muyovu, mukusu) in the Budongo Forest, Bunyoro. Formerly abundant in many Ugandan forests and probably the best cabinet wood of all the East African Meliaceae, but now (2001) scarce due to illegal felling by pitsawyers. Like most of Uganda's mahoganies it regenerates readily in sufficiently open gaps when large enough seed trees are present, and nursery stock can be easily raised and planted. It is susceptible to but usually eventually overcomes shoot-borer, but is extremely palatable to elephant, which can repeatedly destroy all regeneration, natural or planted.
(W.J. Eggeling, *The Forests and the Forest Administration of Uganda*, 1961)

PLATE 11. *Cynometra alexandri* (muhimbi, Ironwood), dominant in parts of the Budongo Forest and other forests in Bunyoro. This exceptionally large buttressed tree illustrates the problems which arise in measurement and felling. Unfortunately many stems are of poor form which, with the very hard timber, makes them difficult to saw economically. Though it provides excellent flooring blocks, there is a limited market for these. The figure is ranger Maurice Kamya who served from before 1937 till after 1965.
(W.J. Eggeling, *The Forests and the Forest Administration of Uganda*, 1961)

PLATE 12. Measurement of girth above buttress of a *Cynometra alexandri* (muhimbi) during the Budongo Forest enumeration, using a linen tape and ring-ended pole. Precise rules, thorough training, careful measurement and frequent checking are necessary to avoid errors and biases in enumerations. The stem partially seen on the left shows how closely large trees sometimes grow in natural forest.
(1954 Annual Report)

PLATE 13. The application of arboricide to a heavily buttressed 'weed' tree in Mpanga Research Forest using a mixture of 2,4,5-T and 2,4-D in diesel and a knapsack sprayer. This effective technique was used to refine large areas of forest after harvesting (especially ones with much unmarketable *Cynometra*), and thus promote and liberate regeneration of more desirable species. It formed the major silvicultural activity in natural forests during the period of this history. Later it fell into disuse, initially because of political upheavals, and more recently due to the surge in nature conservation values.
(*The Forests and the Forest Administration of Uganda*, 1961)

PLATE 14

Plate 14. A demonstration of natural regeneration of desirable species in Mpanga Research Forest after the removal of all understorey weeds. In the background is the dense understorey of an uncleared control plot. Such abundant regeneration was the aim of the refinement technique (Plate 13), but this understorey weeding would not normally be necessary unless diagnostic sampling showed that the regeneration was being suppressed.
(H.C. Dawkins, 1956 Annual Report)

thought to be due to shallow soil and/or drought. A thinning was done to reduce root competition but the deaths continued. The Forest Pathologist, Kenya Forest Department, examined the trees but could find no evidence of fungal attack or insect damage. The deaths continued over the next two years. Soil and leaf samples were analysed and the site examined by the Director, EAAFRO. As a result, it was concluded that the trouble was due to drought combined with general soil poverty, particularly base deficiency, and possibly aggravated by excessive manganese. Fertiliser trials were started but even if they were successful, it was not known how long the effect would last or whether it would be economic to treat large areas.

The shortages and high cost of labour in the plantations of Western Province prompted an increase in the proportion planted in West Nile District, where it was found that satisfactory establishment could be obtained by planting in a single disc-plough furrow. 1961/62 was a record year, a total of nearly 1000 acres (400 ha) being planted but concern was expressed at the high proportion of *P. patula* used. It was hoped to increase the proportion of *P. caribaea* which looked to be one of the most promising introductions but difficulty in getting enough seed of good quality had prevented this hitherto.

There was a considerable drop in the acreage (840 acres, 340 ha) planted in 1962/63 due to the Lendu scheme being almost completed and to the need to deal with arrears of tending. *P. patula* continued to be the major plantation species but due to better seed supplies, a larger acreage (73 acres, 30 ha) equivalent to 9% of the total, of *P. caribaea* was achieved.

Arrears of tending were tackled vigorously and in most areas thinning and pruning were up to date. The total area tended was about 4,500 acres (1,820 ha). The difficulties and costs of high pruning to 32 ft (10m) of final crop trees decreased as the gangs became more experienced in using nylon rope ladders.

The total acreage planted in CFRs in 1963/64 was 725 acres (290 ha), a drop of 115 acres (50 ha) on the previous year. The composition by species was Mexican Pine (*P. patula*) 61%, Cypress (*C. lusitanica*) 24%, Monterey Pine (*P. radiata*) 8%, Honduras Pine (*P. caribaea*) 6% and others 1%. It was decided later to cease planting of *P. radiata* due to its susceptibility to disease (*Dothistroma pini*).

Regeneration of High Forest

(Tables 6A and ALG3A; Plates 9–14)

Until the early 1950s the demand for forest products from the high forest areas of Uganda was confined to one or two well-known species of long rotation. Natural regeneration of these species was in many areas conspicuous by its absence and emphasis was therefore placed on their artificial introduction by more or less diffused underplanting of the selectively logged forest. The picture was, however, changing rapidly: the demand for saw-logs was increasing and large numbers of new species were becoming marketable; impregnation plants were being installed to permit the use of timbers otherwise susceptible to insect and fungus attack. At the same time it was increasingly difficult to maintain the large labour force necessary for any form of diffuse underplanting.

A new pattern was therefore emerging and it was visualised that the high forest would in future be regenerated largely by natural means with appropriate pre- and post-exploitation treatment. A wider range of species would be potential timber producers, many of them of relatively short rotation. It was believed that this method could be introduced immediately in the South Mengo forests but that there was still a lot to be learnt about the western forests.

In many high forest areas, particularly in relatively young forests, woody climbers not only intercepted light at canopy level but were the cause of extensive felling damage at the time of exploitation. It was decided, therefore, to undertake pre-exploitation climber cutting in coupe III of the Budongo Forest and some 2,000 acres (800 ha) were treated in 1952. In the following year climber cutting was carried out in the Mabira and West Mengo concessions but it was not possible to get this work done more than a short time ahead of exploitation. The aim was to complete the climber cutting two years before the timber harvesting was due.

Concurrent with this work, the hardwood timber plantings were tended in Budongo where the 1946 and 1947 compensatory plots of *Khaya* were opened up. A full programme of maintenance of the older diffuse plantings awaited the completion of sample enumerations in the 17,000 acres (6,900 ha) treated.

In South Mengo, no new underplanting was carried out in 1952, all available labour and plants being used on the beeting with striplings and cut-backs of previous years' areas as far back as 1948. Much beeting was required – from 22% to 48% of the original plants needing

replacement. In 1953, a further 300 acres (120 ha) of close spaced underplanting were completed in South Mengo (Zirimiti) which had been incompletely exploited under wartime conditions in 1943. The remaining marketable trees were felled in 1951/52. The species used in the underplanting were *Khaya anthotheca* (57%), *Entandrophragma utile* (20%), *E. angolense* (15%), *Milicia* (*Chlorophora*) *excelsa* (6%) and *Lovoa brownii* (2%). After planting, a canopy opening was carried out – also in the 1948 and 1951 planting areas.

1954 saw the emergence on a field scale of a new technique of mixed forest tending based on the extensive use of contact arboricides for selective 'weeding' or 'refining' at all levels of the forest. The techniques adopted for field use were considered to be largely experimental and would be subject to constant review and improvement as experience was gained. The programme for 'Timber Stand Improvement' (TSI) suffered from unfortunate delays in 1955 in delivery of the arboricides but nevertheless valuable experience was gained. In the Gangu forest (West Mengo) 527 acres (210 ha) were treated using 2% 2,4,5-T in diesel oil and in the Budongo forest 605 acres (245 ha) were treated with a mixture of 1% of 2,4,5-T in oil, increased later to 2%.

The programme of line planting through exploited forest in Mengo was completed in 1954. Canopy and line opening in the Zirimiti forest 1951 regeneration area was completed in 1955. In Mengo pre-exploitation climber cutting was carried out over 3,200 acres (1,290 ha) in 1956 and was well ahead of exploitation.

TSI increased from 1,130 (460 ha) to 3,600 acres (1,460 ha), of which 2,200 acres (890 ha) were in Budongo. During the year, there was considerable development of technique and a 3% solution of 2,4,5-T and 2,4-D in the ratio of 1:2 in heavy diesel oil was standardised. Barrier and cleansing creams and overalls were issued to staff as protection against dermatitis.

Pre-harvesting climber cutting was carried out in 1957 in S Mengo (2,406 acres) (970 ha). Including this together with regeneration inducement and tending (TSI) (4,967 acres, 2,010 ha), the total area treated in Budongo, S Mengo and Masaka was 7,373 acres (2,980 ha), an increase of nearly 1,400 acres (570 ha) over the previous year's figures but still a long way short of the target of 8,000 acres (3,240 ha) a year laid down in the Agricultural Committee's Report. The main reasons for the shortfall were:

(a) lack of sufficient trained sub-professional staff such as Assistant Foresters and Rangers to tackle greater areas;

(b) game damage which made it necessary to delay operations in Budongo CFR for the time being;

(c) unseasonably heavy rains which held up spraying in Budongo.

The aims and methods of high forest treatment continued as before and in 1958 they were codified in the form of a Departmental Standing Order which consolidated experience to date.

During 1958, 4,216 acres (1,710 ha) of forest in Mengo were given pre-harvesting climber cutting. This completed the block which had been partially treated and, with the adoption of the uniform system of silviculture, this work would be discontinued.

A total of 1,513 acres (612 ha) in Budongo were given regeneration inducement. The aim of the treatment was to kill the climbers, weed trees and defectives of the upper and middle storeys so as to increase light at the time of harvesting and promote regeneration of the valuable species, but in the course of the year it became apparent that this treatment, as hitherto applied, was not opening the canopy sufficiently for this purpose. In the last few months of the year, a greater degree of canopy opening was sought by poisoning all muhimbi (*Cynometra alexandri*) above 3 inches (7.6 cm) in diameter.

A total of 7,184 acres (2,910 ha) was given post-harvest tending during the year. Of this, 4,685 acres (1,900 ha) were forest which had been cut over, and 2,179 acres (880 ha) were adolescent forest that had not been previously treated but in which liberation of the young crop was desirable. The remaining 320 acres (130 ha) were forest that had been previously tended and which were given a second experimental tending. The net increase in the area of tended forest was therefore 6,864 acres (2,780 ha). Thus the total area given liberation treatment, pre-harvest regeneration inducement and post-harvest tending treatment during the year was 8,377 acres (3,390 ha), excluding climber-cutting and excluding the 320 acres (130 ha) given an experimental second tending. This represented an increase of about 60% on the previous year's figures and achieved for the first time the target of 8,000 acres (3,240 ha) a year laid down in the Agricultural Productivity Committee Report.

In order to determine how far this rate of treatment was in fact adequate to meet the needs of the situation, a review was made during the year of the progress of treatment in relation to the rate of cutting and the area of previously cut-over forest requiring treatment. This indicated that the current rate of post-harvesting treatment (4,600 acres, 1,860 ha a year) was not enough to keep pace with the then rate of cutting (about 6,700 acres, 2,700 ha a year) and could not make any inroads on the backlog of cut-over forest requiring treatment. There were between 60,000 (24,300 ha) and 70,000 acres (28,300 ha) of such forest which had been cut-over more than five years ago and which needed treatment. The longer this was left untreated, the greater the loss of future increment. Taking account of all the various factors involved, it was estimated that the rate of post-harvesting tending ought to be raised as soon as possible to about 13,000 acres (5,260 ha) a year, to which should be added such pre-harvesting inducement treatment as might be necessary. The gross total, therefore, for both pre- and post-exploitation treatment should be about 14,500 acres (5,870 ha) a year. The limiting factors to this expansion were staff and money, the decisive factor being the former because even if more money were to be forthcoming, no appreciable expansion could be undertaken until more trained sub-professional staff became available. It was hoped that this would be so in two or three years' time.

As foreshadowed in 1958, pre-harvesting climber cutting was stopped although in the light of more recent regeneration assessments it seemed likely that it might be necessary to reintroduce it in some areas.

Regeneration inducement was practised only in the Budongo Forest. Operations progressed normally and a total of 2,821 acres (1,140 ha) was treated over the eighteen-month period 1st January 1959 to 30th June 1960. There was a very satisfactory drop in cost from shs 45 per acre (shs 110 per ha) to shs 24 (shs 60 per ha) despite the more intensive poisoning of

muhimbi introduced in 1958. The decrease was due to more efficient supervision and more care in spraying.

Tending was carried out in Budongo and Kibale forests in the Western Province and in the East and West Mengo and Masaka forests in Buganda. In the Kibale forest, treatment was started for the first time in January 1960.

In East and West Mengo, treatment of the forests which had previously been underplanted was then started in forests which had been cut-over but which had not had any form of silvicultural treatment. In Masaka, treatment was concentrated in unexploited adolescent forest.

In all, a total of 11,906 acres (4,800 ha) over the 18 month period of which 4,121 acres (1,700 ha) were in unexploited forest and 7,785 acres (3,100 ha) in harvested forest. Including the inducement treatment in Budongo, the grand total was 14,727 acres (5,940 ha).

During the 6½ years since treatment began, a total of almost 33,000 acres (13,300 ha) were treated. This hardly kept pace with the current rate of cutting and the aim was, as indicated in 1958, to get the treatment of harvested forest up to about 15,000 acres (6,000 ha) a year. Ministerial approval was given in principle for this and provided the necessary funds were forthcoming, little difficulty was anticipated in achieving it within the next year or two. In the light of the FAO forecast of future timber requirements, however, it would be desirable, when practicable, to raise this rate of 15,000 acres (6,000 ha) a year, which related only to harvested forest, by a further 6,000 acres (2,400 ha) a year in the young unexploited forest which, without treatment, was only putting on minimal increment.

In 1961/62, pre-harvesting climber cutting was carried out in the Mabira and Bugoma forests at an average cost of shs 3 per acre (shs 7 per ha). In the Mabira the work was two years ahead of felling. Regeneration inducement continued ahead of harvesting in Budongo CFR. Diagnostic sampling to determine the composition and state of the crop and hence the type of post-harvesting silvicultural tending required was carried out over approximately 17,500 acres (7,000 ha) in Bugoma, Kibale, Mabira and the lake shore forests. General refining was carried out in Budongo, Bugoma, Kibale, the East and West Mengo and the lake shore forests. A total of 9,775 acres (3,950 ha) were treated, an increase of 8% on the previous year.

In all, 12,083 acres (4,900 ha) of forest were given silvicultural treatment, not counting climber cutting. This was about 120 acres (50 ha) short of the programme, largely because of the wet weather but it was the highest figure achieved to date and its attainment in a particularly wet year was a fine achievement by the field staff concerned. At 30th June 1962, the total area of natural forest given silvicultural improvement treatment of one kind or another was about 63,000 acres (25,000 ha).

In 1962/63, climber cutting continued in West Mengo but not in the Mabira forest, where the area treated was at least two years ahead of schedule. Regeneration inducement continued in Budongo forest and to keep ahead of exploitation, the annual programme had to be increased from 2,000 to 2,500 acres (800 to 1,000 ha). The results of this work were reported to be very striking.

General refining was carried out in Mabira, West Mengo, Jubiya, Sesse, Budongo, Bugoma

PLATE 15

Poles for electricity transmission lines being cut from a ten-year-old coppice crop of *Eucalyptus saligna* (probably actually *E. grandis*) in Kampala Plantations. Large numbers of these were needed for the expansion of the Uganda Electricity Board distribution network in Uganda following the building of the Owen Falls Dam; previously the UEB had imported Norway Spruce poles at great expense. This species was (and still is) the mainstay of fuel and pole production in Uganda.
(*The Forests and the Forest Administration of Uganda*, 1961))

and Kibale forests. In spite of the wet weather which hindered the work considerably, a record total of 13,478 acres (5,400 ha) was treated, an increase of nearly 1,400 acres (560 ha) over the total for the previous year which was itself a record.

As a result of diagnostic sampling in the Mabira forest which indicated that the next crop in the *Celtis–Holoptelea* type of forest would be poorly stocked with desirable species, it was decided that enrichment planting was necessary in this forest type in East and West Mengo. Accordingly large felling gaps and tractor paths were planted with musizi (*Maesopsis eminii*) at spacings of not less than 20 ft (6 m) apart and only in gaps with full overhead light and minimum ground vegetation.

During the year, it was discovered that people exercising their privilege of free poles for their own use in Mengo were cutting pole-sized trees of desirable species in areas which had been refined. As the stocking of such well established regeneration was not high, this practice would have an adverse effect on the future timber crop and attempts were made through talks and distribution of leaflets to enlist the co-operation of the local people in preserving the desirable species although some of them were not reserved.

The aims and methods of the natural regeneration and improvement treatments of high forest remained unchanged as described previously. With the gangs becoming more experienced and the supervision more skilled, the results of the canopy treatments with arboricides were very effective and it was considered in 1963/64 that the results on a large (field) scale were just as good as those obtained in research plots. The tending of natural regeneration in

the high forests continued in 1964 using arboricides to remove weed trees but the policy was changed to treating as soon after exploitation as possible in order to obtain maximum canopy opening to allow light to reach the desirable regeneration. Pre-exploitation treatment was consequently stopped.

Fuel and Pole Plantations

(Tables 6A and ALG3B; plate 15)

Major additions to the plantations ceased in Buganda in 1955 and somewhat later in the other provinces, the reasons being that investigations had shown that the Buganda plantations were sufficient for the probable demand in that region and that the other provinces had completed their programmes. Also, some demands especially in the minor townships and rural areas were increasingly being met from local forest reserves and from peasant planting schemes.

In Buganda, with the help of the Hydrological Department, the main drain in the swamp area between Namanve plantation and the open water of Lake Victoria was realigned in 1952. In spite of this and subsequent attempts to improve the drainage after a rise in lake level due to the building of the Nile dam at Owen Falls and an increase in rainfall, the lower plantations continued to cause much concern and the expensive works brought little improvement, if any. In 1963/64, over 1,100 acres (460 ha) were written off because the crops had been killed by flooding and because it was unlikely that the lake level would go down sufficiently for the area to be utilisable again. So all the sterling work done by Forester Harry Adams in the early 1930s in converting a huge area of papyrus swamp into successful plantations of *Eucalyptus robusta* and *saligna* after three decades of valuable production came eventually to naught.

In the Eastern Province, attempts to accelerate and cheapen the cost of establishment by the use of mechanical ploughing were disappointing owing to unfavourable weather conditions and mechanical troubles. Planting programmes had to be reviewed in the light of continuing labour shortages and all available labour was concentrated on securing full establishment of previous plantings which had suffered from lack of attention.

The Soroti plantations continued to present a most depressing and unhappy picture – regeneration continued to fail and the smoke of burning plantations to darken the Teso sky. Fortunately, the regeneration elsewhere of felled areas was satisfactory.

In the Western Province, the Eucalyptus plantations of Fort Portal continued to be the main source of pit props for Kilembe copper mine. A further 12 acres of *E.saligna* (5 ha) were planted in drained swamp land there and the spectacular growth of previous plantings was maintained. No new areas were established at Katwe in the Queen Elizabeth National Park but attention was directed to preventing and repairing the ravage of big game in this highly productive plantation. The efforts were, however, unsuccessful and the plantation gradually disappeared under the onslaughts of the game. It appeared that its survival could only be possible by prohibitively expensive expenditure on fencing and 100 acres (40 ha) were written off in 1956.

At Mbarara, the combination of unfavourable soil and climatic factors, short supply of labour and over-supply of termites had its usual depressing effect on the plantation.

In the Northern Province, another satisfactory planting year was recorded at Arua in 1951 and it was hoped that the chronic fuel shortage in the township would be overcome in the following year. These excellent plantations of *E. saligna* were extended by a further 63 acres (25 ha) in 1953 but, later, serious mortality occurred suddenly over wide areas under very puzzling conditions. No pathological symptoms were detected and it appeared that the deaths were caused by drought. A further 54 acres (22 ha) were planted successfully. An important minor product of these plantations was the little bunches of leaves without which the ladies of the district were disturbingly underdressed.

In Lango, after consultation with the medical authorities, 39 acres (16 ha) of unimpressive anti-malarial plantations in Lira were written off. The main block was drained and managed chiefly for pole production. It was reported that 'the trees also afford a cool retreat for foresters and birds'.

Similarly, in Acholi, with the concurrence of the Medical Department, sections of the anti-malarial plantations at Gulu were abandoned as productive areas, part being taken over by the Township Authority as an amenity area. These areas had been consistently uneconomic so with the change in malaria control by DDT and drugs it was a relief to be able to excise them from the formal working plan areas.

The most urgent artificial regeneration problem remained – to find a suitable species for short rotation fuel and pole crops in the northerly areas of the country: a drought resistant and termite resistant species which could be relied upon to form a dense enough canopy to suppress the rhizomatous grasses, *Imperata* and *Digitaria*.

In 1947, a promising introduction had been the Hunters Rise strain of the *Eucalyptus camaldulensis* which for the first four years grew at the rate of 9.5 feet (2.9m) per annum on good sites. But the early promise of this introduction and of other red gums was not maintained and E.saligna was preferred. Further trials of *E. camaldulensis* (*aff. tereticornis*) from Zanzibar were made over the ten year period to 1961 when at last this species was accepted as a successful substitute for *Cassia siamea* as a pole and fuel crop in the savannah areas of the Northern region, where drought and termites seriously affect *E.saligna*.

Nursery Work

Towards the end of 1958, the Horticulturist, EAAFRO visited a number of nurseries and gave instruction to local staff in nursery work. His chief criticisms were that the Rangers in charge were, in too many cases, not sufficiently practical and that the work was spread over too many small scattered nurseries. Largely as a result of his visit, there was a marked improvement in the standard of work and considerable economies in the cost of raising plants in the Eastern Province. Nurseries were centralised both there and in Buganda. Later however in 1962/63, nursery practice continued to give inconsistent results, in spite of all the time given to it in recent years. The main faults were poor pricking out and unsatisfactory soil mixtures.